Thermophysical Properties of Liquids and Spinodal Approximation

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The spinodal, i.e. the boundary of essential phase instability, separates at the system thermodynamic surface the region of metastable states from that of absolutely unstable (labile) states. By the thermodynamic theory of stability in this line $(\partial\rho / \partial \mathrm{v})_T = 0$, T/c_ρ =0.The position of the spinodal can be determined by the results of measuring the thermal properties of substances in the stable and the metastable regions. The agreement of data by the results of approximating the spinodal from different properties may be regarded as the corroboration of the trustworthiness of information on the boundary of essential phase instability. The paper discusses various means of approximating the spinodal of superheated liquid by data on thermal properties. $\mathrm{P},\rho,\mathrm{T}$ – properties are extrapolated into the metastable region by isochores, which are close to straight lines. The spinodal is found as the envelope of isochores in p,T –coordinates. The isothermal elasticity β_T^{-1} is extrapolated into the metastable region by isochores. The spinodal is the line in which $\beta_T^{-1} = 0$. The lines of constant sound velocity in p,T – coordinates have the spinodal as their envelopes. This property is used to find the spinodal from acoustic dates.

Isotherms of the reduced absorption factor $(\alpha / f^2)^{-1}$ against the pressure are close to straight lines. In the spinodal $(\alpha / f^2)^{-1} = 0$. Lines of constant value of isochoric heat capacity c_v in p,T –coordinates have the spinodal as their envelopes. This property can be used for its finding. Data on the isobaric heat capacity c_p may be used for finding the spinodal by extrapolating into the metastable region the thermal stability coefficient T/c_p by isochore. The thermal conductivity coefficient λ is included in the dynamic stability criterion $\lambda/\rho c_p$. By extrapolating this complex into the metastable region one can find the spinodal from the condition $\lambda/\rho c_p$=0.